

CLAIMS

What is claimed is:

1. A computer controlled method for evaluating selected surface and physical optical properties of structures made wholly or partly from fibers, polymers, films or a combination thereof, said method comprising the steps of:
  - (a) illuminating the surface of a structure;
  - (b) obtaining a digitized image from the illuminated surface of the structure; and
  - 10 (c) computer processing of the digitized image to determine a property of the structure selected from the group consisting of:
    - (1) a fiber orientation distribution (ODF) of the fibers on the surface of the imaged structure; (2) basis weight non-uniformity (blotchiness) of the structure; (3) pilling on the surface of the
    - 15 structure; and (4) texture function of the structure.
2. The method according to claim 1 including illuminating the surface of a structure with a direct, collimated, dark-field, or coaxial light source.
- 20 3. The method according to claim 1 including obtaining a digitized image from the illuminated surface of the structure with a camera.
4. The method according to claim 1 including creating a fiber orientation distribution (ODF) of fibers on the surface of a structure selected from

the group comprising nonwovens, paper and their respective composites.

5. The method according to claim 4 including processing of the ODF to rank the ODF against known standards.
6. The method according to claim 1 including measuring basis weight or structure non-uniformity (blotchiness) of a structure selected from the group comprising webs; papers; and nonwovens and composites made from one or more of these materials.
7. The method according to claim 6 including processing of the basis weight non-uniformity against known standards.
8. The method according to claim 1 including determining pilling on the surface of a structure selected from the group comprising woven and knit constructions.
9. The method according to claim 8 including processing of surface pilling against known standards.
10. The method according to claim 1 including determining texture function of a structure selected from the group comprising woven, knit and non-woven constructions.

11. The method according to claim 10 including processing of the texture function against known standards.
12. A computer controlled method for evaluating selected surface and physical optical properties of structures made wholly or partly from fibers, polymers, films or a combination thereof, said method comprising the steps of:
  - (a) illuminating the surface of a fibrous structure;
  - (b) obtaining a digitized image from the illuminated surface of the structure; and
  - (c) computer processing of the digitized image including use of at least one algorithm selected from the group comprising: Fourier transform; hough transform; direct tracking; ridge tracking; edge tracking and flow field analysis to create a fiber orientation distribution (ODF) of the fibers on the surface of the imaged fibrous structure.
13. The method according to claim 12 including illuminating the surface of a fibrous structure with a direct, collimated, dark-field, or coaxial light source.
14. The method according to claim 12 including illuminating the surface of a fibrous structure by transmitting light from a light source through a diffuser and a beam splitter onto the fibrous structure supported by a

mirror therebeneath to facilitate obtaining the digitized image by a camera positioned above the fibrous structure.

15. The method according to claim 12 including obtaining a digitized image  
5 from the illuminated surface of the structure with a camera.
16. The method according to claim 12 including computer processing of the  
digitized image with a Fourier transform algorithm to create a fiber  
orientation distribution (ODF) of the fibers on the surface of the imaged  
10 fiber structure.
17. The method according to claim 12 including creating a fiber orientation  
distribution (ODF) of fibers on the surface of fibrous structure selected  
from the group comprising non-wovens, paper and their respective  
15 composites.
18. The method according to claim 13 including processing of the ODF to  
rank the ODF against known standards.
- 20 19. A computer controlled method for evaluating selected surface and  
physical optical properties of structures made wholly or partly from  
fibers, polymers, films or a combination thereof, said method comprising  
steps of:  
(a) Illuminating the surface of a fibrous structure;

- (b) obtaining a digitized image from a structure sample size of at least  $10 \times 10 \text{ cm}^2$ ; and
- (c) computer processing of the digitized image including breaking the digitize image into windows of at least  $1 \times 1 \text{ cm}$  for analysis of size effect in order to determine basis weight non-uniformity (blotchiness) of the fibrous structure.
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20. The method according to claim 19 including illuminating the surface of the structure with a direct, collimated, dark-field, or coaxial light source.
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21. The method according to claim 19 including illuminating the surface of the fibrous structure by transmitting light from a light source through a diffuser and a beam splitter onto the fibrous structure supported by a mirror therebeneath to facilitate obtaining the digitized image by a camera positioned above the fibrous structure.
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22. The method according to claim 19 including measuring basis weight or structure non-uniformity (blotchiness) of a structure selected from the group comprising webs; papers; nonwovens and composites made from one or more of these materials.
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23. The method according to claim 22 including processing of the basis weight non-uniformity against known standards.

24. A computer controlled method for evaluating selected surface and physical optical properties of structures made wholly or partly from fibers, polymers, films or a combination thereof, said method comprising the steps of:

- 5 (a) circularly illuminating the surface of a fibrous structure having pilling thereon by transmitting light at an acute angle of between about 4° and 60° to the surface of the structure to provide dark field imaging of the surface structure wherein little light is reflected by the surface and significant light is reflected by pills and surface defects thereon;
- 10 (b) obtaining a digitized dark field image of the surface of the structure; and
- (c) computer processing of the digitized image to determine pilling on the surface of the structure.

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25. The method according to claim 24 including illuminating the surface of the structure with a direct, collimated or dark-field transmitted light source.

20 26. The method according to claim 24 including the determining pilling on the surface of a structure selected from the group comprising woven and knit constructions.

27. The method according to claim 26 including processing of surface pilling against known standards.
28. A computer controlled method for evaluating selected surface and physical optical properties of structures made wholly or partly from fibers, polymers, films or a combination thereof; said method comprising the steps of:
- (a) illuminating the surface of a fibrous structure by transmitting light at a acute angle thereto between about 10° and 80° in order to highlight raised features on the surface of the structure;
- (b) obtaining a digitized image of the structure of the surface; and
- (c) computer processing of the digitized image including use of an algorithm to determine texture periodicity and corresponding amplitude in order to determine the texture function of the structure.
29. The method according to claim 28 including illuminating the surface of the structure with a direct, collimated or dark-field transmitted light source.
30. The method according to claim 28 including computer processing of the digitized image with a Fourier transform (FT) to determine the texture function of the substrate.

31. The method according to claim 28 including computer processing of the digitized image with a co-occurrence method to determine the texture function of the substrate.
- 5 32. The method according to claim 30 and 31 including computer processing of the digitized image with a Fourier transform (FT) method to determine the texture index or fingerprint of the substrate.
33. The method according to claims 28 including determining texture  
10 function of a structure selected from the group comprising woven, knit and non-woven constructions.
34. The method according to claim 33 including processing of the texture function against known standards.